



Effect of Lime and Rice Husk Ash on Engineering Properties of Black Cotton Soil

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Abstract: Black Cotton Soils exhibit high swelling and shrinking when exposed to changes in moisture content and hence have been found to be most troublesome from engineering considerations. This behaviour is attributed to the presence of a mineral montmorillonit. The wide spread of the black cotton soil has posed challenges and problems to the construction activities. To encounter with it, innovative and non traditional research on waste utilization is gaining importance now a days. Soil improvement using the waste material like Slags, Rice husk ash, Silica fume etc., in geotechnical engineering has been in practice from environmental point of view. The main objective of this study is to evaluate the feasibility of using Rice Husk Ash with lime as soil stabilization material. A series of laboratory experiment has been conducted on 0.5% lime mixed black cotton soil blended with Rice Husk Ash in 10%, 20% and 30% by weight of dry soil.

Keywords: Black cotton soil, Soil Stabilization, Rice husk ash, Engineering Properties

I. INTRODUCTION

The wide spread of the black cotton soil has posed challenges and difficulties in the construction activities because of its shrink-swell behavior and low strength. The inadequate natural stability of black cotton soil can be reduced using various techniques; one of them is through admixtures. Stabilization techniques can be adopted on large scale when the treatment is low cost and durable. Rice husk ash is one of the major wastes found abundantly. The annual production of paddy is one of the major wastes found abundantly. In India, the annual production of paddy is about 100 million tones. The burning of rice husk generates about 20% of its weight as ash. Thereby generating more than 4 million tons of rice husk ash. Hence research work is done on utilization of rice husk ash in improvement of geotechnical characteristics of black cotton soil. In the present investigation, an attempt has been made to evaluate the changes in the compaction and strength characteristics of black cotton soils such as optimum moisture content, maximum dry density, CBR and UCS in addition of 0.5% lime and rice husk ash in different proportions.

II. LITERATURE REVIEW

Satyanarayan *et al.*, 2004 studied the effect of FA and lime on the expansive soil used for construction of road base, sub base (Satyanarayan *et al.*, 2004). Stabilization of expansive soil using rice husk ash (RHA) as a pozzolanic material along with a binder has been studied by researchers a number of times (N K Bhasin *et al.*, 1988), (A S Muntohar and G Hantoro, 2000), Effect of RHA with cement (E A Basha *et al.*, 2003), (A N Ramakrishna and A V Pradeep Kumar, 2006),

effect of RHA with calcium chloride (R S Sharma, 2008), effect of RHA with marble dust (A K Sabat and R P Nanda, 2011), effect of RHA and lime with gypsum (D K Rao *et al.*, 2011) etc. Similarly the mixing of lime sludge along with a pozzolanic material has also been studied. Some are bagasse ash with lime sludge (A K Sabat, 2012), fly ash with lime sludge (R K Srivastava *et al.*, 1997). Chandra *et al.* had stabilized a nonexpansive clayey soil with RHA and lime sludge (S Chandra *et al.*, 2005). RHA added to soil was from 5 to 20% in steps of 5% and lime sludge from 4 to 16% in steps of 4%. Properties of the stabilized soil studied were, Atterberg's limits, maximum dry density (MDD), optimum moisture content (OMC), unconfined compressive strength (UCS) and soaked California bearing ratio (CBR) of soil. Sabat (A K Sabat, 2012) had studied the stabilizing effects of bagasse ash and lime sludge on compaction properties, UCS, CBR and swelling pressure of an expansive soil, Brooks (2009) studied the potential of Rice Husk Ash (RHA) and fly ash (FA) blended soil as a swell reduction layer between the footing of a foundation and subgrade. He recommended 12% and 25%, RHA and FA, respectively, for modifying the expansive subgrade soil. Ali *et al.* (2004) studied the effect of RHA and lime on characteristics of bentonite. (Ali M and Sreenivasulu V, 2004).

III. MATERIALS AND METHODS

A series of laboratory tests were conducted on 0.5% lime mixed BC Soil blended with RHA in various percentages i.e. 10%, 20% and 30 % by weight of dry soil. The following tests were conducted on 0.5% lime mixed BC soil and Rice mixes; as per relevant IS Code. The tests are

1. Compaction Test
2. Shrinkage limit
3. Unconfined Compressive Strength
4. Plastic limit of soil
5. Direct Shear Test

BLACK COTTON SOIL

The black cotton soil used in this study was collected from The Chhattisgarh is located in the central part of India, between the latitudes of 17°46–24°8 N and the longitudes of 80°15–84°24 E.

RICE HUSK ASH

The stabilizer materials used in this study was Rice Husk Ash. Rice Husk Ash used in this study collected from Rice Mill, Dist. Durg (C.G.). The properties of RHA is presented in Table 1. The black cotton soil was mixed with 0.5%lime and soaked for four days. After oven drying, the following samples are prepared by mixing different percentage of rice husk ash to it.

Table 1. Chemical & Physical properties of RHA

Oxide composition % by mass	RHA
Sio ₂	88.32
Al ₂ O ₃	0.46
Fe ₂ O ₃	0.67
CaO	0.67
MgO	0.44
Na ₂ O ₃	0.12
K ₂ O	2.91
LOI	5.81
Specific gravity	2.11

IV. RESULTS AND DISCUSSION

The tests results are summarized in Table 3. The variation in the Optimum moisture contents, Maximum dry density, California bearing ratio, unconfined compressive strength and Differential free index are shown in Figures 1 to 2.

Table 2 Summary of Result

MIX	PLASTIC LIMIT	PROCTOR COMPACTION
BCS	29.67%	0.136
RHA 10	22.35%	0.15
RHA 20	28.14%	0.08
RHA 30	27.03%	0.07

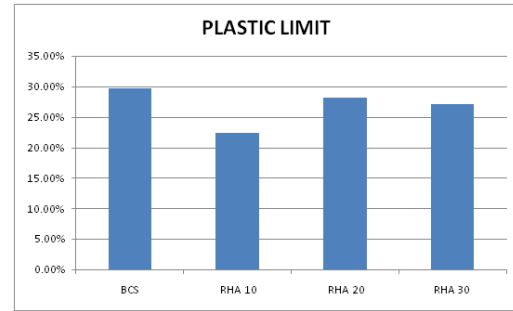


Figure No 1 Plastic Limit

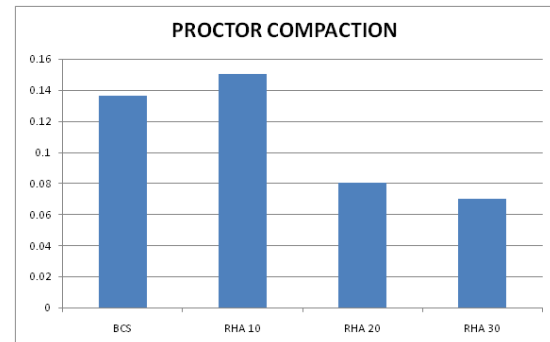


Figure No 2 Proctor Compaction Test

V. CONCLUSION

From the results of the investigation carried out within the scope of the study the following conclusion can be drawn

- Based on Specific gravity of a soil- With mixing of RHA, specific gravity of the soil increases by 0.3%. Strength of the soil is directly proportional to specific gravity, more is the specific gravity more will be the strength of soil.
- Based on liquid limit of a soil - Soil without RHA and with RHA have liquid limit difference of 16.46%.
- Based on plastic limit of a soil - As similar to liquid limit the plastic limit of soil is also reduces. It reduces from 29.35% to 27.03%. % decrease in plastic limit is 2.32%, This result shows increase in shear strength Cohesiveness and consistency of soil mass.
- Based on liquid limit of a soil - The value of the shrinkage limit in black cotton soil is greater than that of soil with RHA. Hence with the use of RHA shrinkage increases.
- The differential free swells decreases, showing appreciable decrease in swelling behavior.
- Thus the improvement in index properties of soil reveals that rice husk ash is an important material to stabilize the black cotton soil & make suitable for construction purpose.

- It is observed that addition of RHA enhances not only the strength development but also the durability of lime stabilized soil.

VI. REFERENCES

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